REINFUSION OF SHED BLOOD: NOT WORTH THE COSTS AND RISKS

Surgery Grand Rounds Debate
August 18, 2008
Douglas Benson, R3
Outline

- Risks of Reinfusion
  - Contamination
  - Coagulopathy
  - Inflammatory Markers

- Cost Effectiveness
  - Cost
  - Reduction in allotransfusions?
Pt: Exposure to air and tissue

Suction and Processing: Mechanical stress to cells

Filtration: Removal of platelets and coag factors

Compared Factors for Mediastinitis in 11 pts compared to 33 random controls

- BMI>30
- Abx w/in 2 wks of surgery
- >6hr use of autotransfusion

Increase in early fevers, band neutrophilia, wound infections with transfused SMB

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Patients With Mediastinitis</th>
<th>Control Subjects</th>
<th>OR (95% CI)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfusion &gt; 2 U packed RBCs, No. (%)</td>
<td>6 (73)</td>
<td>10 (48)</td>
<td>2.8 (0.7–11.2)</td>
<td>0.15</td>
</tr>
<tr>
<td>Mean (SD) duration of autotransfusion, h</td>
<td>8.5 (6.4)</td>
<td>4.0 (5.7)</td>
<td></td>
<td>0.03</td>
</tr>
<tr>
<td>Total mean mediastinal drainage, mL</td>
<td>1,394</td>
<td>1,127</td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Total mean autotransfusion volume, mL</td>
<td>659</td>
<td>344</td>
<td>5.5 (1.3–22)</td>
<td>0.05</td>
</tr>
<tr>
<td>Autotransfusion used for &gt; 6 h, No. (%)</td>
<td>7 (64)</td>
<td>8 (24)</td>
<td>5.5 (1.3–22)</td>
<td>0.02</td>
</tr>
</tbody>
</table>
More Contamination

- Nosanchuk, *ArchPathLabMed* 2001
  - 31 units of processed blood through Cell-Saver from 18 pts undergoing elective spinal surgery
  - 19/31 units culture positive
  - No pt developed positive cultures or turned septic

  - 287 units of Autologous blood
    - 2/59 positive for ATDP infused intra-op
    - 3/81 ATDP transfused post-op
    - 3/117 HAT
    - 10/30 IOBS
  - No episodes of sepsis reported
- 40 CABG pts
- 20 infused SMB, 20 infused SMP after washing
- Abnormal TEG in both groups
- Effect worse in unwashed blood

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 (n=16)</th>
<th>Group 2 (n=17)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ICU arrival baseline</td>
<td>Final</td>
</tr>
<tr>
<td>Reaction time (23.6±4.8 mm)</td>
<td>25.2± 3.7</td>
<td>39.4± 7.1</td>
</tr>
<tr>
<td>K time (10.6± 2.8 mm)</td>
<td>17.2± 3.4</td>
<td>37.5± 8.0</td>
</tr>
<tr>
<td>α angle (36.0± 7.4 degrees)</td>
<td>32.6± 4.8</td>
<td>19.7± 5.0</td>
</tr>
<tr>
<td>Max amplitude (54.0± 3.7mm)</td>
<td>56.6± 3.7</td>
<td>48.1± 5.0</td>
</tr>
<tr>
<td>TEG index (0± 2.0)</td>
<td>-0.3± 0.6</td>
<td>-2.8± 0.6</td>
</tr>
<tr>
<td>Sample</td>
<td>APTT(s)</td>
<td>(24-34)</td>
</tr>
<tr>
<td>--------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td>Grp 1</td>
<td>Grp 2</td>
</tr>
<tr>
<td>T1</td>
<td>28±4</td>
<td>29±6</td>
</tr>
<tr>
<td>T4</td>
<td>39±8</td>
<td>38±5</td>
</tr>
<tr>
<td>T5</td>
<td>34±5</td>
<td>33±5</td>
</tr>
<tr>
<td>T6</td>
<td>32±5</td>
<td>30±5</td>
</tr>
<tr>
<td>T7</td>
<td>30±4</td>
<td>29±4</td>
</tr>
<tr>
<td>T8</td>
<td>28±3</td>
<td>28±4</td>
</tr>
</tbody>
</table>

- 40 pts, CABG or valve
- 20/20 processed/unprocessed blood
- Impaired hemostasis in both groups
- Reduced plasma proteins, plts, and coag factors in washed blood
- Less post-operative blood loss in washed group

10 AVR pts

Suction led to increased release of pro-inflammatory markers

Filtration-normalization of some but not all markers

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-op</th>
<th>Intra-op</th>
<th>Post-op</th>
<th>Cardiotomy Suction</th>
<th>Haem 1</th>
<th>Haem 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(µg/L)</td>
<td>(µg/L)</td>
<td>(µg/L)</td>
<td>(µg/L)</td>
<td>(µg/L)</td>
<td>(µg/L)</td>
</tr>
<tr>
<td>IL-6</td>
<td>2 (1-6)</td>
<td>10 (8-30)</td>
<td>113 (38-115)</td>
<td>52 (18-89)</td>
<td>178 (77-843)</td>
<td>9 (2-30)</td>
</tr>
<tr>
<td>IL-8</td>
<td>13 (10-19)</td>
<td>20 (16-29)</td>
<td>29 (20-43)</td>
<td>26 (24-42)</td>
<td>95 (54-106)</td>
<td>39 (27-63)</td>
</tr>
<tr>
<td>TNF-α</td>
<td>0 (0-4)</td>
<td>1 (0-5)</td>
<td>0 (0-2)</td>
<td>24 (20-33)</td>
<td>22 (0-33)</td>
<td>0 (0-0)</td>
</tr>
<tr>
<td>TAT</td>
<td>5 (3-15)</td>
<td>43 (32-73)</td>
<td>81 (40-108)</td>
<td>113 (99-153)</td>
<td>693 (586-870)</td>
<td>137 (20-313)</td>
</tr>
<tr>
<td>PAP</td>
<td>427 (285-505)</td>
<td>489 (393-607)</td>
<td>653 (496-773)</td>
<td>566 (505-658)</td>
<td>899 (644-965)</td>
<td>20 (14-34)</td>
</tr>
<tr>
<td>Plts (10^3 /µL)</td>
<td>195 (154-220)</td>
<td>137 (123-158)</td>
<td>124 (113-151)</td>
<td>127 (114-144)</td>
<td>60 (49-66)</td>
<td>14 (11-17)</td>
</tr>
<tr>
<td>Free Hgb (mg/dL)</td>
<td>24 (18-34)</td>
<td>30 (27-32)</td>
<td>38 (31-43)</td>
<td>61 (50-70)</td>
<td>500 (342-652)</td>
<td>58 (45-62)</td>
</tr>
</tbody>
</table>
50 cardiac surgery patients

10 pts in five groups assigned to 5 different types of Cell savor

- Analyzed conc of markers before/after processing
  - IL-1β, IL-2, IL-6, IL-8
  - TNFα
  - Elastase
  - MPO

- Adequate attenuation
  - IL-6
  - TNFα

- Increase in concentration
  - IL-1β

- Low attenuation
  - IL-2, IL-8
  - Elastase
  - MPO
What does all this mean?

- **IL-1β**
  - Derived from stimulated mononuclear phagocytes
  - Major endogenous pyrogen

- **IL-2**
  - Pro-inflammatory, produced by T<sub>h</sub> cells

- **IL-8**
  - Powerful chemoattractant peptide for neutrophils

- **Plasma-free Hgb**
  - Activates macrophages
  - Potential renal injury

- **Elastase, MPO**
  - Activated oxygen species
  - Markers of leukocyte activation, degranulation
  - Causes: exposure to air, foreign surfaces

- **Contribution to SIRS post-operatively?**

- 198 Heart pts
  - 98 auto-transfused
  - 100 control
- Less exposure to allotranfusion
- Same amount of blood products transfused
- More post-operative bleeding in autotransfusion group (1200±201ml vs 758±152ml)

<table>
<thead>
<tr>
<th>Products</th>
<th>Reinfusion group</th>
<th>Control group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRBCs</td>
<td>1.8±0.7</td>
<td>2.2±0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Plts</td>
<td>3.2±1.2</td>
<td>2.7±0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>FFP</td>
<td>1.3±0.7</td>
<td>0.9±0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Cryo</td>
<td>0.4±0.3</td>
<td>0.4±0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Total</td>
<td>6.7±2.7</td>
<td>6.4±1.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Pts transfused (%)</td>
<td>54(55)</td>
<td>73(73)</td>
<td>0.01</td>
</tr>
</tbody>
</table>
- 102 cases of posterolateral fusion
  - 56 Cell Saver
  - 46 Control
- Post-op Transfusion
  - 36% vs 50%
- Blood related charges
  - $512-cell saver vs $270-control

Freischlag, *CritCare* 2004
- Review of vascular surgery studies using cell saver
- Cost analysis
  - Washing cells removes contaminants
    - Also plts, coag factors, more expensive
  - Cost-effective only if 2+ units recovered from saver
    - $475 for set-up
    - $202.75 1st unit, $154.25 additional
Although clinical significance of contamination is unproved, safety cannot be guaranteed.

Coagulopathy and bleeding continue to be a problem.

Autotransfused blood has many elevated inflammatory markers that could add to the post-operative SIRS.

Trials to date are small randomized controlled, and non-blinded.

The unproven benefits of cell-salvage do not outweigh the costs at this time.

A more conservative approach to transfusion may further reduce the need for cell salvage.
Thank You
Questions?
References